

REMARKS

Applicants thank the Examiner for the courtesy of a telephone interview on September 21, 2005. During the interview, Applicants' representatives, Robert Bain and associate Robert Enyard, discussed proposed amendments to the pending claims and the patentability thereof in view of the cited references. In particular, the arguments below were presented. The Examiner acknowledged that proposed claim amendments appear to distinguish the present invention from the cited references in that the cited references fail to teach or suggest a magnet having an external reinforcement wound on a superconducting coil before the coil is impregnated with epoxy such that the reinforcement and superconducting coils are impregnated in the epoxy together to provide structural reinforcement to the magnet in both radial and axial directions. Applicants provided the Examiner with a copy of a proposed amendment to claim 1 for discussion purposes, but no exhibit was shown and no demonstration was conducted. The Examiner and applicants' representatives did not formally reach an agreement.

Applicants have thoroughly considered the Examiner's remarks in the Office action mailed June 23, 2005 and respectfully acknowledge the Examiner's allowance of claims 20 and 21. Claim 1 has been amended and claim 22 has been canceled by this Amendment C. Thus, claims 1-21 are now presented in the application for further examination and applicants request reconsideration of the claims in view of the following remarks. The remarks follow the sequence of the Office action.

Rejections Under 35 U.S.C § 103

Claims 1-10 and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Koyama et al., U.S. Patent No. 5,606,300, in view of Ito, Japanese Patent No. 58,194,309 A. As an initial matter, applicants point out that claim 23 was canceled in Amendment B. The Office acknowledges that the Koyama reference does not disclose reinforcement of the coil, but contends that it would have been obvious to one of ordinary skill in the art at the time the invention was made to wrap the coil of Koyama with the reinforcement wire of Ito to prevent the movement of a superconductive wire due to

electromagnetic force thereby improving stability. (See Office action at page 3). As explained below, the cited references, even when combined as suggested in the Office action, fail to teach or suggest all of the features of applicants' claims. Thus, *prima facie* obviousness has not been established. (See MPEP 2142 and 2143).

To illustrate the differences between the cited references and the claimed invention, applicants point out that the present application discloses and claims a superconducting magnet that comprises an integral external reinforcement on at least one of the superconducting coils of the magnet. As explained in the present application, there are two main components of mechanical forces in the windings of high field magnet coil, namely, a radial force that tends to expand the diameter of the coil and an axial force at each end that tends to compress the coil (i.e., make the coil shorter). According to embodiments of the present invention, a conductor (i.e., a superconducting wire forming the magnet coil) and a reinforcement wire are *first wound in sequence and then epoxy impregnated together in a common epoxy impregnation and cure process*. This coil configuration is referred to as having *integral external reinforcement* because it "achieves the primary objectives of radial and axial mechanical support of the conductor windings in a superior manner by having essentially the same strength at the interface between the coil 102 and reinforcement 108 as within the two." (See application page 13, paragraph 52). In other words, the superconducting coil is first wound and then before being impregnated with epoxy, the external reinforcement is wound on the superconducting coil. Although the reinforcement wire is wound externally around the magnet coil it is integrated with the coil via the common epoxy impregnation process, and, thus, a high quality epoxy composite is achieved throughout coil and reinforcement winding with high strength at the interface between the two materials. (See application page 16, paragraph 60). In contrast, even if the Koyama and Ito references are combined as suggested by the Examiner, the combination fails to teach or suggest integrating the magnet coil and reinforcement wire via a common epoxy.

Moreover, wrapping a coil that has already been impregnated with epoxy is not the same as wrapping a coil with a reinforcement wire and impregnating both the coil and reinforcement wire with epoxy. In the former, the reinforcement wire is external to the coil but is not integrated. In the latter, the coil is both integrated and external to the coil.

Nothing in the cited references, whether considered in combination or separately, suggests a magnet with such *integral external reinforcement*. Even if a reinforcement winding (such as taught by Ito) is applied to the coil (such as taught by Koyama) there are major drawbacks. For example, in order to apply Ito's reinforcement winding to Koyama's finished coil (after the coil has already been epoxy-impregnated), the coil must be refitted in the winding machine for the application of the reinforcement. Although this requirement may not be severe for a small coil, as the size of the coil increases for higher field magnets, such as the wide bore magnet of claim 1 (which can weigh over a ton), this processing step becomes increasingly burdensome. Furthermore, applying epoxy later to the reinforcement cannot achieve the desired bond between the reinforcement and the coil winding because fresh epoxy would have to be applied by a wet lay-up process over the already cured epoxy. In other words, the epoxy of the reinforcement wire and the epoxy of the magnet coil cannot be molecularly linked. Thus, the strength of the interface between the coil and the reinforcement winding as taught by the combination of Koyama and Ito would be inferior. (See application page 5, paragraph 14). For these reasons, applicants submit that the coil of Koyama and the reinforcement wire of Ito cannot be impregnated together via a common epoxy and, thus, cannot provide integral external reinforcement as set forth in claim 1. The distinction between applicants' inventions and the teachings of the cited references is made even clearer in claim 2, which requires a wind and react conductor. As explained above, the combination of Koyama's coil and Ito's reinforcement would either suffer from an unbonded epoxy interface or the epoxy would be destroyed during the heat treatment to react the conductor.

Applicants have amended claim 1 to more clearly set forth the invention. Amended claim 1 recites, in part, a superconducting magnet having a bore width greater than approximately 100 millimeters and "an *integral external reinforcement* on at least one of the superconducting coils." According to claim 1, the reinforcement comprises "an external reinforcement wound on the at least one superconducting coil *before* said coil is impregnated with epoxy, said reinforcement and said at least one of the superconducting coils being impregnated in the epoxy *together* for providing structural reinforcement to the magnet in both radial and axial directions."

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Thus, whether considered alone or in combination, the Koyama and Ito references fail to teach or suggest an external reinforcement wound on a superconducting coil that is impregnated in epoxy together with the superconducting coil. Accordingly, claim 1 is allowable over the cited references.

Claims 12-18 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Koyama in view of Ito and in further view of Huang et al., U.S. Patent No. 6,147,844. However, Huang also fails to teach or suggest integral external reinforcement as claimed and described in the present application.

Claims 2-19 depend from claim 1 and are believed to be allowable for at least the same reasons as the claim from which they depend.

Claims 20-21 have been allowed.

It is felt that a full and complete response has been made to the Office action, and applicants respectfully submit that claims 1-22 are in condition for allowance. If the Examiner feels, for any reason, that a follow-up personal interview will expedite the prosecution of this application, he is invited to telephone the undersigned.

The fact that applicants may not have specifically traversed any particular assertion by the Office should not be construed as indicating applicants' agreement therewith.

Any required fees or overpayments should be applied to Deposit Account No. 19-1345.

Respectfully submitted,



Robert M. Bain, Reg. No. 36,736
SENNIGER POWERS
One Metropolitan Square, 16th Floor
St. Louis, Missouri 63102
314/231-5400